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Two fast X-ray transients in archival Chandra data

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ABSTRACT

We present the discovery of two new X-ray transients in archival *Chandra* data. The first transient, XRT110103, occurred in January 2011 and shows a sharp rise of at least three orders of magnitude in count rate in less than 10 s, a flat peak for about 20 s and decays by two orders of magnitude in the next 60 s. We find no optical or infrared counterpart to this event in preexisting survey data or in an observation taken by the SIRIUS instrument at the Infrared Survey Facility ~ 2.1 yr after the transient, providing limiting magnitudes of $J > 18.1$, $H > 17.6$ and $K_s > 16.3$. This event shows similarities to the transient previously reported in Jonker et al. which was interpreted as the possible tidal disruption of a white dwarf by an intermediate mass black hole. We discuss the possibility that these transients originate from the same type of event. If we assume these events are related a rough estimate of the rates gives 1.4×10^5 per year over the whole sky with a peak 0.3 – 7 keV X-ray flux greater than 2×10^{-10} erg cm⁻² s⁻¹. The second transient, XRT120830, occurred in August 2012 and shows a rise of at least three orders of magnitude in count rate and a subsequent decay of around one order of magnitude all within 10 s, followed by a slower quasi-exponential decay over the remaining 30 ks of the observation. We detect a likely infrared counterpart with magnitudes $J = 16.70 \pm 0.06$, $H = 15.92 \pm 0.04$ and $K_s = 15.37 \pm 0.06$ which shows an average proper motion of 74 ± 19 milliarcsec per year compared to archival 2MASS observations. The JHK_s magnitudes, proper motion and X-ray flux of XRT 120830 are consistent with a bright flare from a nearby late M or early L dwarf.

Key words: X-rays: bursts – infrared: stars – stars: flare – stars: late-type

1 INTRODUCTION

Astronomical transients represent huge releases of energy, often on very short timescales, and their discovery and follow-up allows us to probe the extreme physics involved. X-rays, being associated in large part with compact, high energy density processes such as accretion, can reveal much of the astrophysics in such events. The brightest X-ray sources in the sky are associated with accreting neutron stars and black holes and the vast majority are highly variable.

Transients which can be detected as variable within individual *Chandra* observations would be variable on timescales of seconds up to tens of kiloseconds for the longest observations. Within our galaxy the major populations of X-ray transients exhibiting bursting behaviour on time-scales of seconds to hours come from flare stars and X-ray binary systems. Flare stars can produce X-ray bursts on time-scales of minutes to hours due to magnetic reconnection events in the stellar atmosphere (Osten et al. 2005). Accre-

tion events in the bulk of X-ray binaries can show variability on these timescales, but in general with no more than $\sim 50\%$ amplitude (e.g. Lewin & van der Klis 2006). Type I X-ray bursts are observed in neutron star X-ray binaries and are caused by thermonuclear flashes from accreted material on the neutron star surface (e.g. Strohmayer & Bildsten 2006; Galloway et al. 2008). These occur on time-scales of a few to hundreds of seconds releasing total energy of around $10^{39} - 10^{40}$ ergs. Supergiant fast X-ray transients (SFXTs) are high mass X-ray binary systems with supergiant companions. SFXTs can produce X-ray flares on typical time-scales of 100–10,000 s (Sidoli 2013).

Extragalactic populations of X-ray transients such as X-ray rich gamma-ray bursts and X-ray flashes (Sakamoto et al. 2008) can produce rapid bursts of X-rays with a wide range of peak energies. Typically tidal disruption events evolve over too long a timescale (months to years, e.g. Komossa et al. 2004) to be detected as variable over a single *Chandra* observation but the time-scale of the event decreases with black hole mass, radius of the disrupted star and the impact factor (beta) (e.g. equation 4 of Lodato

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& Rossi 2011). This suggests the possibility of faster X-ray transients from the tidal disruption of compact stars around intermediate mass black holes (e.g. in the case of white dwarfs see Rosswog, Ramirez-Ruiz, & Hix 2009).

There have recently been two discoveries of *Chandra* transients on time-scales of hundreds of seconds with probable extragalactic origin. Jonker et al. (2013) report a transient close to M86 with possible precursor events and a peak luminosity $\sim 6 \times 10^{42}$ erg s $^{-1}$ (assuming the distance of M86). This was interpreted as the possible tidal disruption of a white dwarf by an intermediate mass black hole, although other explanations such as an off-axis GRB are not ruled out. Luo, Brandt, & Bauer (2014) report a transient in the Chandra Deep Field-South survey of duration ~ 1 ks possibly associated with a R=27.38 (AB) galaxy with photometric redshift 0.31 ± 0.16 (Treister, Bauer, & Schawinski 2014).

In this paper we report the discovery of two faint X-ray transients in archival *Chandra* data. The analysis is split into two parts covering each transient discovered in turn. Follow up near-infrared and archival Very Large Array (VLA), Two Micron All Sky Survey (2MASS) and United States Naval Observatory (USNO-B) observations of the field are analysed in a search for possible counterparts. We also analyse the spectral evolution of the transient discovered by Jonker et al. (2013), XRT 000519. We then discuss the probable nature of these transients including the possibility that one is of similar nature to those discovered recently by Jonker et al. (2013) and Luo, Brandt, & Bauer (2014).

2 OBSERVATIONS AND ANALYSIS

We have searched the Chandra Data Archive for rapid transient events, making use of the Chandra Source Catalog (Evans et al. 2010) and conducting our own search of data publicly released from 2010 onwards (Glennie et al. in preparation).

There is a rich sample of statistically variable sources in the Chandra Data Archive. We present two of the more unique transient sources discovered, which appear to be relatively bright and evolve over a short timescale. The first was discovered in an observation of the galaxy cluster ACO 3581 with observation identification number (ObsID) 12884 which began on 2011 January 3. We name this transient after the date of the event, XRT 110103. The observation in which the second transient was discovered was targeting the galaxy cluster SPT-CLJ2352-4657 with ObsID 13506 beginning 2012 August 30. We name this transient XRT 120830.

The details of the *Chandra* observations and source coordinates are listed in Table 1. All errors given are to the 1σ level of significance unless otherwise stated. The *Chandra* data processing was done using CIAO 4.5 and CALDB 4.5.6. The source positions were derived using the CIAO tool WAVDETECT. Source photons for each transient were extracted from a circular region centred on the WAVDETECT position with radii of $30''$. This relatively large extraction region is warranted by the large off-axis angle of the transients of 13.3 and 12.3 arcmin for XRT 110103 and XRT 120830 respectively. In each case using an annulus as the background region would extend beyond the edge of the ACIS CCD so a nearby region of radius $60''$ was chosen, centred on RA & DEC $14^{\text{h}}08^{\text{m}}30^{\text{s}} - 27^{\circ}05'28''$ for XRT 110103 and $23^{\text{h}}52^{\text{m}}11^{\text{s}} - 46^{\circ}41'47''$ for XRT 120830. The tool SPECEXTRACT was used to extract the source spectra and XSPEC 12.8.0 used for spectral fitting. In each case source photons in the range 0.3 - 7.0 keV were used for spectral analysis and the Cash statistics (Cash 1979) used to determine the best-fit model parameters.

Table 1. Details of the observations and coordinates for each transient. The source position uncertainties are estimated using the method set out in Evans et al. (2010) including the ChaMP positional uncertainty relations (Kim et al. 2007) and the astrometric error calculated by Rots & Budavári (2011).

Transient	ObsID	RA & DEC J2000	Error
XRT 110103	12884	$14^{\text{h}}08^{\text{m}}28^{\text{s}}.89 - 27^{\circ}03'29''.4$	$1''.1$
XRT 120830	13506	$23^{\text{h}}52^{\text{m}}12^{\text{s}}.19 - 46^{\circ}43'43''.3$	$1''.5$

Follow up near-infrared observations with the SIRIUS instrument at the Infrared Survey Facility (IRSF, Nagayama et al. 2003) were analysed using STARLINK GAIA 4.4.4. Archival VLA data of the field were reduced using the VLA Calibration Pipeline 1.2.0 and imaging and analysis performed with CASA 4.1.0.

2.1 XRT 110103

The evolution of the count rate as a function of time of XRT 110103 is shown in Figure 1. The lightcurves were extracted with the maximum time resolution for ACIS of 3.24 s. The top panel shows the evolution of the transient over the entire observation. In the periods of the observation where we obtain a low count rate we average time bins together to ensure a minimum of 10 counts per bin. The vertical line on the top panel indicates the time period shown in the bottom panel to illustrate the features of the main flare. In the 6560s of the observation prior to the main flare we do not significantly detect the source above the background count rate of 4.1×10^{-3} counts s $^{-1}$. During the main flare the count rate increases by more than 3 orders of magnitude in less than 10 s, there is a flat peak for around 20 s and then a steady decay of around 2 orders of magnitude in the next 60 s. We detect some spectral softening over the duration of the flare, illustrated with the hardness ratio in Figure 1. We have defined the hardness ratio as follows and used 6.48 s time bins to maximise signal to noise.

$$\text{Hardness} = \frac{F_h - F_s}{F_s + F_m + F_h}$$

Where F_s , F_m and F_h are the photon fluxes in the soft (0.5 - 1.2 keV), medium (1.2 - 2 keV) and hard (2 - 7 keV) bands. After the main flare the source follows a more gradual decay for ~ 20 ks after which it is not significantly detected above the background count rate for the remainder of the observation.

XRT 110103 was discovered in an observation of the galaxy cluster ACO 3581. However, the nearest known member of the galaxy cluster, ACO 3581 12, is 2.7 arcmin from the *Chandra* transient position. We obtained a follow up observation with the IRSF on 2014 March 14, ~ 2.1 yr after the transient detection. Details of the observation are shown in Table 2. Figure 2 shows the J-band image from this observation. There is no counterpart within the *Chandra* error circle, placing limiting magnitudes (5σ) of $J > 18.1$, $H > 17.6$ and $K_s > 16.3$. We find no optical counterpart in the USBO-B catalog (Monet et al. 2003) implying a limit of $R > 20.9$. We also analysed an archival L-band (1.34 - 1.73 GHz) VLA observation of the field taken ~ 1.4 yr after the transient (project code SB0410 starting on 2012 May 11). We found no counterpart down to an upper limit of 0.25 mJy beam $^{-1}$ (three times the root-mean-square noise at the position of the transient).

We have fitted an absorbed powerlaw model (pegpwlw in Xspec) to the X-ray spectrum of the main burst with various values for the absorption. A total of 470 source photons were taken from

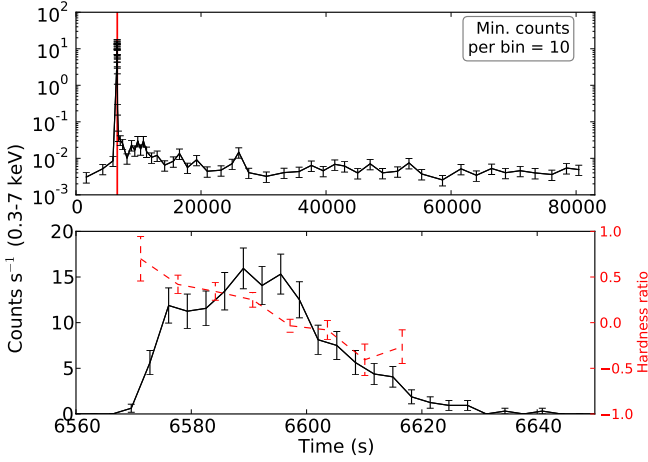


Figure 1. Lightcurves of XRT 110103 showing the variability over the entire *Chandra* observation (top panel, logarithmic count rate) and a close-up of the main flare (bottom panel, linear count rate). The vertical line on the top panel indicates the time period shown in the bottom panel. The dashed (red) line indicates the evolution of spectral hardness (axis on the right of the bottom panel). The time resolution of the bottom panel lightcurve is 3.24 s and the hardness ratio is 6.48 s. The source is not detected over a background count rate of 4.1×10^{-3} counts s^{-1} prior to the main flare (the lightcurves are not background subtracted).

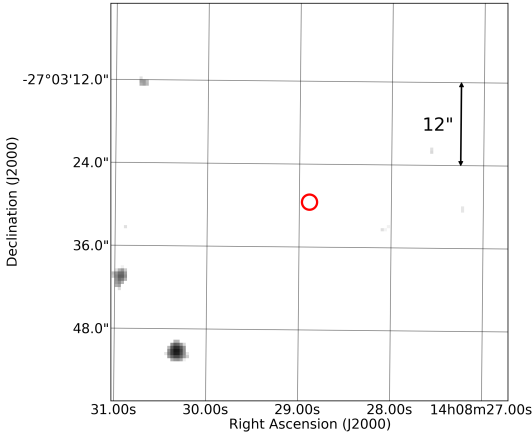


Figure 2. This IRSF/SIRIUS *J*-band image shows the 1σ *Chandra* position of XRT 110103 is not consistent with any infrared source we detect. We have used a Gaussian smoothing with a kernel radius of 1 pixel.

the 60 s following the start of the transient event as shown in the bottom panel of Figure 1. The results of these fits are shown in Table 3. A fit was calculated with no absorption, another with the expected line of sight Galactic foreground value of $N_H = 4.3 \times 10^{20}$ (Dickey & Lockman 1990) and finally leaving the N_H parameter free to find the best fit.

Table 2. Summary of the follow up observations taken with IRSF/SIRIUS.

Target	Telescope	Date	Seeing	Exposure (s)
XRT 110103	IRSF/SIRIUS	14 March 2014	2''/4	1500
XRT 120830	IRSF/SIRIUS	8 December 2013	1''/8	1380

Table 3. A powerlaw model was fit to the X-ray spectrum of XRT 110103 with various corrections for absorption due to the column density, N_H . The value of $N_H = 4.3 \times 10^{20} \text{ cm}^{-2}$ is the expected absorption due to the galactic foreground (Dickey & Lockman 1990). The value of $N_H = 5.5 \times 10^{21} \text{ cm}^{-2}$ was found by leaving the N_H parameter free to converge on the best fit.

N_H (cm^{-2})	Peak Flux ($\text{erg cm}^{-2} \text{ s}^{-1}$)	Photon Index
0	$(1.1 \pm 0.1) \times 10^{-10}$	1.3 ± 0.1
4.3×10^{20}	$(1.2 \pm 0.1) \times 10^{-10}$	1.4 ± 0.1
$(5.5 \pm 1) \times 10^{21}$	$(2.2 \pm 0.4) \times 10^{-10}$	2.3 ± 0.2

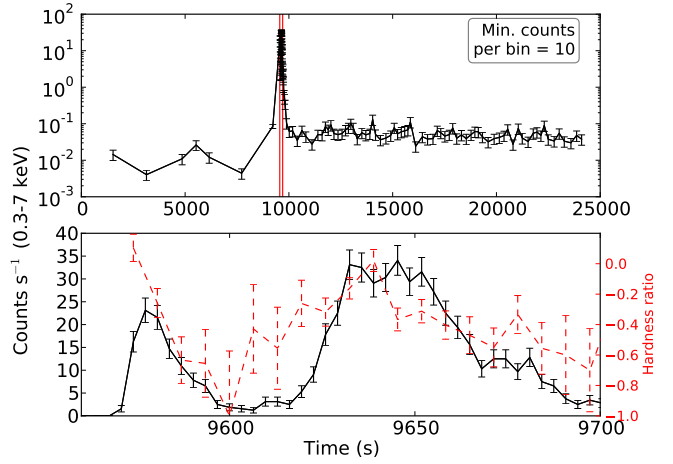


Figure 3. Lightcurves of XRT 000519 showing the variability over the entire *Chandra* observation (top panel, logarithmic count rate) and a close-up of the main flare (bottom panel, linear count rate). The vertical lines on the top panel indicate the time period shown in the bottom panel. The dashed (red) line indicates the evolution of spectral hardness (axis on the right of the bottom panel). The time resolution of the bottom panel lightcurve is 3.24 s and the hardness ratio is 6.48 s.

2.2 XRT 000519

XRT 000519 is a transient originally discovered by Jonker et al. (2013), also in archival *Chandra* data. It comes from a direction close to M86 and evolves over a similar timescale to XRT 110103. XRT 000519 shows some possible precursor events ~ 4 and ~ 8 ks prior to the main flare. Jonker et al. (2013) found some spectral softening between the first and second bursts but did not display the spectral evolution of the source at greater time resolution. We have applied the same hardness ratio as for XRT 110103 and provide in Figure 3 an equivalent plot of the lightcurve and hardness ratio for comparison.

2.3 XRT 120830

For XRT 120830 we show in Figure 4 the lightcurve for the whole *Chandra* observation. The lightcurve was extracted with 3.24 s time resolution with bins combined at low count rate periods to ensure a minimum number of 10 counts in each bin. We provide a close up of the main flare in the bottom panel to indicate the rapid rise and fall in count rate. XRT 120830 is not significantly detected prior to the main burst. We are unable to fully resolve the rise time of the main flare with the 3.24 s time resolution of ACIS. The count rate increases by 3 orders of magnitude from the background level

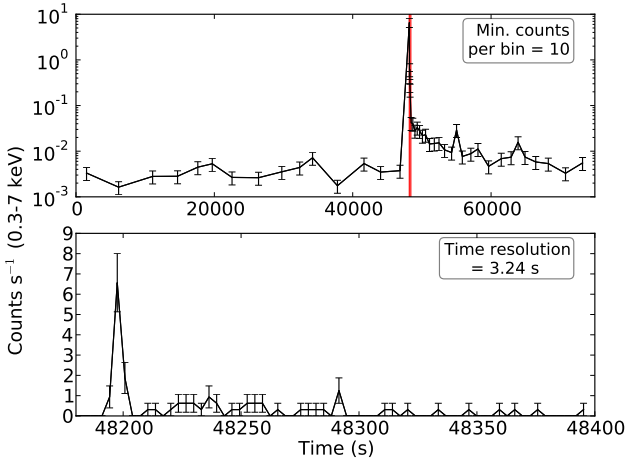


Figure 4. Lightcurves of XRT 120830 showing the variability over the entire *Chandra* observation (top panel, logarithmic count rate) and a close-up of the main flare (bottom panel, linear count rate) with 3.24 s time resolution. The vertical line on the top panel indicates the time period shown in the bottom panel. The source is not detected over a background count rate of 2.5×10^{-3} counts s^{-1} prior to the main flare (the lightcurves are not background subtracted).

Table 4. Magnitudes in the *J*, *H* and *K_s* bands for the transient XRT 120830.

Telescope	<i>J</i> -band	<i>H</i> -band	<i>K_s</i> -band
2MASS	16.8 ± 0.2	15.9 ± 0.2	15.5 ± 0.2
IRSF/SIRIUS	16.70 ± 0.06	15.92 ± 0.04	15.37 ± 0.06

and then rapidly decays by more than an order of magnitude from the peak count rate. This rise and decay occurs in approximately 10 s. The transient continues to decay for the remainder of the observation, with some marginally significant flaring events ~ 7 and 14 ks after the main burst.

We found a possible faint infrared counterpart to XRT 120830 in the 2MASS catalog (Skrutskie et al. 2006). We followed this up with an observation with the Infra-Red Survey Facility (IRSF) on 2013 December 8, ~ 1.3 yr after the transient was detected. A candidate counterpart was detected in the IRSF observation and was found not to have varied in the *J*, *H* and *K_s* bands from the 2MASS survey (see Table 4). The position is also consistent with a Wide-field Infrared Survey Explorer (Cutri et al. 2012) point source with magnitudes $W1=15.108 \pm 0.035$ $W2=15.133 \pm 0.076$. We find no optical counterpart in the USBO-B catalog (Monet et al. 2003) implying a limit of $R > 20.1$. We find an offset of $1''.05$ between the 2MASS and IRSF/SIRIUS positions. Taking the $0''.25$ uncertainty from the 2MASS catalog and assuming a typical $0''.1$ uncertainty for the IRSF detection (Kato et al. 2007) we find a proper motion of 74 ± 19 milliarcsec per year. Given the dates of the 2MASS and IRSF/SIRIUS observations we estimate the source would need to be within ~ 10 pc for parallax to contribute significantly to the uncertainty in this calculation. We suggest in the discussion that a distance of around 80 pc is more likely. This offset is illustrated in Figure 5. From the source density of the field we calculate the probability of a chance association between the *Chandra* transient and the infrared counterpart to be approximately 1 percent.

We have fitted a powerlaw model (pegpwlw in Xspec) to the

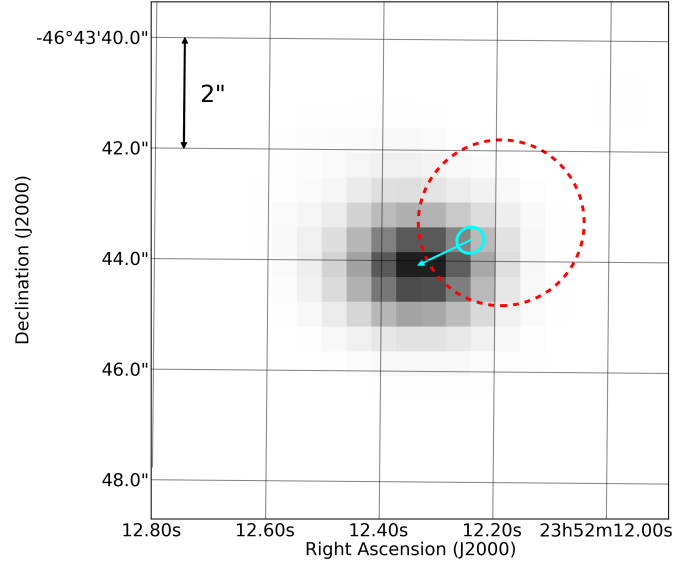


Figure 5. This *J*-band image from IRSF/SIRIUS shows the candidate infrared counterpart to XRT 120830. We have used a Gaussian smoothing with a kernel radius of 1 pixel. The 2MASS error region is indicated with a solid blue circle. The projected motion between the 2MASS observation (1999 September 20) and the IRSF/SIRIUS observation (2013 December 8) is indicated with an arrow. The error circle from the *Chandra* observation is displayed as a red dashed circle. The date of the *Chandra* observation was 2012 August 30.

X-ray spectrum of XRT 120830. As the proper motion of the possible counterpart suggests this is a nearby source we apply no correction for absorption. Due to the low count rate we have taken source photons from the start of the burst to the end of the observation to get as many counts as possible. We find a photon index of 2.5 ± 0.2 and a peak flux of $(8.7 \pm 0.7) \times 10^{-11}$ erg cm^{-2} s^{-1} . We do not find a sufficient count rate to follow the spectral evolution of the source with a hardness ratio.

3 DISCUSSION

3.1 XRT 110103

Without a counterpart and a subsequent redshift measurement it is not clear whether XRT 110103 is at the distance of the galaxy cluster ACO 3581 or originates from a foreground or even more distant object. If it is associated with the cluster ACO 3581 that would place it at a distance of 94.9 Mpc (Johnstone et al. 2005), implying a peak luminosity of $\sim 2 \times 10^{44}$ erg s^{-1} . The Galactic latitude of XRT 110103 is $b \sim 32.7$ suggesting a possible Galactic source is unlikely to be further than ~ 1 kpc. At this distance, the peak luminosity would be $\sim 2 \times 10^{34}$ erg s^{-1} which suggests an X-ray burst is unlikely (Galloway et al. 2008).

XRT 110103 exhibits similar properties to the transient XRT 000519 reported by Jonker et al. (2013). Both evolve over a similar time-scale with the main burst taking place over a few hundred seconds and a slow powerlaw decay over the remainder of each observation. The lightcurve of XRT 000519 showed a twin peak in the main flare which is not evident in XRT 110103. Both have similar powerlaw spectra and were detected in observations of galaxy clusters. However, we are unable to associate XRT 110103 with any known counterpart within the cluster ACO

3581. XRT 000519 displayed precursor events ~ 4 and 8 ks before the main flare. In the 6 ks of observations prior to the main flare of XRT 110103 we find no precursor events. XRT 110103 is a factor of a few fainter in flux so we cannot rule out the possibility that similar precursor events are present but below our detection threshold. Jonker et al. (2013) offer multiple explanations for XRT 000519, favouring the tidal disruption of a white dwarf by an intermediate mass black hole. They do not rule out alternative scenarios such as the accretion of an asteroid by a foreground neutron star or an off-axis γ -ray burst (GRB).

Jonker et al. (2013) estimate a peak luminosity for XRT 000519 of $\sim 6 \times 10^{42}$ erg s $^{-1}$ assuming a transient distance of 16.2 Mpc, equivalent to that of M86. If these events are due to the tidal disruption of a white dwarf by an intermediate mass black hole the different peak luminosities could be due to different black hole masses or due to different beaming factors (e.g. MacLeod et al. 2014). The transient recently discovered in the Chandra Deep Field-South survey (Luo, Brandt, & Bauer 2014) could also be related to XRT 110103 and XRT 000519. The count rate quoted by Luo, Brandt, & Bauer (2014) and redshift for a potential counterpart galaxy of 0.31 (Treister, Bauer, & Schawinski 2014) suggest a peak luminosity of $\sim 4 \times 10^{44}$ erg s $^{-1}$.

These events could also be interpreted as X-ray flashes, which are probably related to GRBs (e.g. Sakamoto et al. 2005). The time-scale of the main flares and the late-time powerlaw decays seen in XRT 110103 and XRT 000519 are consistent with the early X-ray emission typically seen in GRB lightcurves (e.g. O’Brien et al. 2006). Figure 7 in Sakamoto et al. (2005) shows the peak energy constraints on X-ray flashes, X-ray-rich GRBs and Hard GRBs. Of these scenarios, the upper limits on the peak energy of XRT 110103 and XRT 000519 from the power law fits could only be consistent with an X-ray flash. However, for XRT 000519 the Burst and Transient Source Experiment (BATSE) detected no gamma-ray burst at the time of the X-ray transient (Jonker et al. 2013).

If XRT 110103 and XRT 000519 are the same type of object we provide an estimate of the rates for these events. We searched a total of 8.4 years of ACIS-I and ACIS-S public data with no grating used and found two events of this type. Assuming an approximate 16×16 arc-minute field of view we derive a rate of 1.4×10^5 per year over the whole sky with a peak X-ray flux greater than 10^{-10} erg cm $^{-2}$ s $^{-1}$. There are significant biases in the sky sampling from *Chandra* observations. If these transients are extragalactic then X-ray absorption in any Galactic plane observations would likely result in any such transients being obscured. Further if these events are associated with galaxy clusters then the *Chandra* observations devoted to clusters (approximately 18.5 per cent of ACIS observations are listed in this science category) would have a greater chance of observing such an event than a random location on the sky. Without firm knowledge of the nature or distance of these transients it is difficult to account for these possible biases. This combined with the small sample size suggests this rate should be treated as a very rough approximation. As we have two similar transients with such a large flux there should be many more fainter transients of a similar nature in the *Chandra* archive. There should also be events in the archives of other soft X-ray telescopes such as *ROSAT*. Assuming a lightcurve and model similar to the best fit we find for XRT 110103 and a log-N log-S slope of -1.5 we calculate that there should be as many as 100 such events in the *ROSAT* All Sky Survey with greater than 15 photons detected. Greiner et al. (2000) may have found some of these events.

3.2 XRT 120830

XRT 120830 has a Galactic latitude of $b \sim -67.2$ which suggests a Galactic source would be within ~ 1 kpc. At this distance we find a peak luminosity of $\sim 10^{34}$ erg s $^{-1}$ which again makes an X-ray burst unlikely.

The proper motion of 74 ± 19 milliarcsec per year for the likely counterpart to XRT 120830 suggests a flare from a nearby dwarf star as the most likely explanation for the X-ray transient. If we assume a typical tangential velocity for a local dwarf star of ~ 25 km s $^{-1}$ (e.g. see figure 7 of Faherty et al. 2009) we find a distance of ~ 80 pc. The absolute magnitude of $M_J \sim 12.2$ at such a distance would imply a dwarf star around the L1 spectral type (see equation 6 and figure 7 in Cruz et al. 2003). The infrared colours are also consistent with a late M or early L dwarf (e.g. figure 6 in Cruz et al. 2003), suggesting that this is plausible distance. At this distance we estimate a peak X-ray luminosity of $\sim 7 \times 10^{31}$ erg s $^{-1}$. Larger peak X-ray luminosities have been reported in superflares for earlier type M dwarfs (e.g. Osten et al. 2010). This may be the largest X-ray flare detected in such a late type dwarf, although the distance and spectral type are uncertain. Spectroscopic followup is required to confirm both the spectral type and provide a more accurate distance estimate.

The marginal flaring events 7 and 14 ks after the main flare could be related to the rotation period of the dwarf star in this case, although we cannot draw any firm conclusions regarding periodicity from 3 events. A ~ 2 hour rotation period would be rapid for an M dwarf (e.g. Delfosse et al. 1998) but some late-type dwarfs have comparable periods such as BRI 0021-0214 at ~ 2.5 hours (Basri & Marcy 1995) and 2MASSW J1707183+643933 at 3.6 hours which has also displayed a strong flare with an amplitude in the UV of at least 6 mag (Rockenfeller et al. 2006).

4 CONCLUSIONS

In summary, we have discovered two previously unknown transients in archival *Chandra* data. One of these events, XRT 110103, could be extra-galactic in nature and deeper optical follow-up of XRT 110103 should help to determine the nature of this transient. Combined with XRT 000519 and the transient reported by Luo, Brandt, & Bauer (2014) there is a population of *Chandra* transients which could be of similar nature. A wider sample of such objects, from the *Chandra* archive or other soft X-ray telescopes, should help to determine whether these events are related to a known class of transient.

XRT 120830 appears to be consistent with an X-ray flare from a late M or early L dwarf star. We are unable to confirm the precise spectral type of the dwarf from the infrared colours and magnitudes. The possible minor flares ~ 7 and 14 ks after the main flare could be related to the rotation period of the star.

Whilst telescopes with a large field of view such as *Swift-BAT* are ideal for detecting large numbers of transients those discovered serendipitously during routine observations can provide unique information. Soft X-ray lightcurves and spectra are available for the entire transient event in this case rather than being limited to the afterglow. In the case of XRT 000519 the availability of a lightcurve prior to the main flare revealed possible precursor events. However, discovery years after the event means followup observations are likely to miss the decay phase of most transients. Some form of quick alert system could rectify this, even if only alerting the principal investigator of the observation if data exclusivity periods must be adhered to.

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